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PATENT SPECIFICATION 772,354

Inventor :—WILLIAM ROBERT BELDAM.

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International Classification :—B01d.

COMPLETE SPECIFICATION.

Improvements in Filters for Removing Fine Particles from Liquids.

We, AUTO-KLEAN STRAINERS LIMITED, a Company registered under the laws of Great Britain, of 115 Staines Road, Hounslow, in the County of Middlesex, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to filters for removing fine particles from liquids and is concerned with filters employing a filter cartridge in which a filtering layer is superimposed upon a tabular former, said layer consisting of a rigid element or elements providing a plurality of accurately dimensioned apertures or slots adapted to permit the passage of the liquid to be filtered but not of solid particles of a size above a predetermined minimum. The said filtering layer may be in the form of wire gauge, or helically wound wires, or a plurality of closely spaced rings or annular discs.

It is an object of the invention to provide an improved filter cartridge which is adapted to be removably secured in a filter unit so that it is readily detached for cleaning, repair, or replacement, and in which a sleeve or wrapping of fibrous material is so secured on the inner filtering layer that most of the solid particles above a minimum size are removed from the liquid before it reaches the inner filtering layer.

According to the invention a filter cartridge for removing fine particles from liquids and adapted to be removably secured in a filter unit, comprises a tabular former, an inner filtering layer superimposed upon the former, and consisting of a rigid element or elements providing a plurality of accurately dimensioned apertures or slots, and an outer filtering layer of fibrous material consisting of a plurality of turns of convolutely wound sheet material formed into a sleeve by means attaching the outer turn of material securely to the underlying turn or turns.

The sleeve may be secured on the former by wire bindings or spring circlips which press the material of the sleeve into annular V-section grooves in the former. The attaching means may be one or more longitudinal lines of stitching attaching the outer turn of material to the underlying turn or turns and extending along a part or the whole of the length of the sleeve. The sleeve preferably comprises more than two turns of sheet material, the starting edge of the sheet being stitched for at least part of its length to the overlying turn of material, the succeeding turn of material overlapping the first line of stitching and the finishing edge of the sheet being stitched along its length to the immediately underlying turn only, out of register with the first line of stitching, whereby at least one complete turn of material is provided that contains no stitch-holes. A suitable material for the sleeve is a closely felted sheet of fibres, of animal or vegetable origin, such as a felt cloth or a filter paper.

In order that the invention may be more clearly understood, one form thereof will now be described by way of example with reference to the accompanying drawings in which :—

Fig. 1 is a perspective view of a former of a filter cartridge shown partly wound with wire to provide a filtering surface, one end piece being omitted ;

Fig. 2 is a perspective view of the same cartridge after the winding of the wire has been completed and shows a sheet of felt material in the process of being wound around the former ;

Fig. 3 is a similar view to that of Fig. 2 showing the felted sheet material completely wound on and secured to the former ; and

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Fig. 4 is an axial section of a filter unit incorporating the filter cartridge shown in Fig. 3.

In accordance with the present invention, a filter cartridge indicated generally at 1 in Figs. 1, 2 and 3 comprises a cylindrical former 2 of a rigid material which will not be corroded by the liquid to be filtered, the wall of the former being perforated as at 3 to permit the passage of the liquid therethrough and being provided with longitudinally extending ribs 4 equally spaced around the circumference thereof, these ribs 4 being provided with a discontinuous helical groove 5 accurately to locate the turns of a wire 6 the adjacent turns of which define between them a slot of such a size as to permit the passage of the liquid to be filtered but not of solid particles of a size above a predetermined minimum. One end of the former 2 is provided with an end piece 7 which completely closes that end of the former apart from an axial bore 8 extending through a boss 9 formed on the end piece 7 and utilised in accurately locating the cartridge 1 within the housing 10 of a filter unit. The other end of the cartridge has secured therein an end piece 11 having a spider 12 formed with a through bore 13 which is also utilised in locating the cartridge 1 within the housing 10.

A sheet of felted fibrous material 14, which is permeable by the liquid to be filtered but which will normally retain all solid particles of a size above the predetermined minimum size, is tightly wrapped around the filtering surface provided by the wire 6 on the former 2. After one complete turn of the felted material has been applied, the starting edge is stitched for at least part of its length to the overlying material as at 15 (Fig. 2) and the material is then wound around for a further two turns to provide three layers of felted material on the outside of the cartridge. The succeeding turns of material are arranged to overlap the first line of stitching at least twice, the finishing edge of the sheet being stitched along its length to the immediately underlying turn only, out of register with the first line of stitching, whereby liquid flowing radially through the filter unit will pass through at least one layer of material which contains no stitch-holes. The width of the sheet of material is such as to over-lie at least part of the circumference of each of the end pieces 7 and 11 of the former 2, which end-pieces are formed with V-section annular slots 17 and 18 respectively, into which the material is pressed by means either of wire bindings 19 and 20, as shown, or of spring circlips similarly engaged with the material, to seal the sheet of felted material tightly against the end pieces 7 and 11 of the former 2 so that any liquid supplied to the cartridge is constrained to flow through the felted sheet material 14 before passing through the slots defined by the adjacent turns of the wire 6.

An example of a filter unit in which the cartridge 1 described above may be advantageously employed is illustrated in Figure 4. The housing 10 is formed with a flanged inlet 21 and a flanged outlet 22, the cartridge 1 being co-axially located within the cylindrical housing 10 by means of a spindle 23 which passes through the apertures 8 and 13 formed in the end pieces 7 and 11 respectively, of the cartridge 1. The spindle 23 threadedly engages the end wall 24 of the housing the other and open end of which is sealed by means of a cap 25 seating on a ring 26 secured in the open end. The cap 25 is urged into sealing engagement with the ring 26 by means of a nut 27 engaging the threaded end of the spindle 23 which extends through the cap 25. An inwardly directed annular flange 28 is provided adjacent to the closed end of the housing 10 to receive, as a close fit the end piece 11 of the cartridge 1. The latter is urged axially of the housing by means of a spring washer 29 bearing at one end against the boss 9 and at the other end against an adjusting nut 30 screwed on the spindle 23, the edges of the layers of the material 14 being pressed against the flange 28 to constitute a seal. An annular space or chamber 31 is left between the outer surface of the cartridge 1 and the inner wall of the housing 10.

In the operation of the filter unit the liquid to be filtered is supplied under pressure into the chamber 31 of the housing 10 by way of the flanged inlet 21 and in order to reach the flanged outlet 22, has to pass through the three layers of the felted material 14, through the slots defined by the adjacent turns of the wire 6 and the apertures 3 formed through the wall of the former 2 to the interior of the cartridge 1. As the liquid passes through the felted material 14 most of the suspended solid particles above the predetermined minimum size are retained by the material so that when the liquid reaches the filtering surface proper provided by the slots defined by adjacent turns of the wire 6 the liquid is substantially filtered and any particles above the predetermined minimum size which pass through the material 14 are retained by the wire 6 to complete the filtering operation, the quantity of matter retained by the wire 6 being considerably less than would be the case if the material 14 were not provided.

It has been found that a defined mesh filter of the kind specified, when fitted with a porous sheet of the nature indicated, may be operated continuously for relatively long periods, with complete satisfaction, at substantially higher flow ratings than is possible in the absence of the porous sheet. The latter

clearly absorbs or holds within its interstices the majority of the solid matter suspended in the liquid to be filtered and it might be thought that this porous material alone would afford the filtering efficiency required. However, this is not the case because such porous materials are never completely homogeneous in structure and "channels" soon occur therein, i.e. there arise openings through which comparatively large solid particles may pass. When employed as specified above, the defined mesh of the filtering surface proper retains any particles which may pass through the porous material and at the same time provides a strong and rigid support for the latter which will prevent distortion or collapse of the porous material under the action of high differential pressures.

Moreover, the rigid supporting of the porous material reduces the "sponging" effect normally encountered with such materials, i.e. the discharge into a fresh flow of liquid passing through the material of quantities of large solids previously abstracted from liquid which was filtered prior to a stoppage of the flow for any reason.

It will be understood that the porous sheets used in accordance with this invention will be replaced by fresh ones from time to time.

What we claim is :—

1. A filter cartridge for removing fine particles from liquids and adapted to be removably secured in a filter unit, comprising a tubular former, an inner filtering layer superimposed upon the former, and consisting of a rigid elementor elements providing a plurality of accurately dimensioned apertures or slots, and an outer filtering layer of fibrous material consisting of a plurality of turns of convolutely wound sheet material formed into a sleeve by means attaching the outer turn of material securely to the underlying turn or turns.

2. A filter cartridge according to Claim 1, wherein the sleeve is secured on the former by wire bindings or spring circlips which press the material of the sleeve into annular V-section grooves in the former.

3. A filter cartridge according to Claim 1 or 2, wherein the attaching means comprises one or more longitudinal lines of stitching attaching the outer turn of material to the underlying turn or turns of material and extending along a part or the whole of the length of the sleeve.

4. A filter cartridge according to Claim 3, wherein the sleeve comprises more than two turns of sheet material, the starting edge of the sheet being stitched for at least part of its length to the overlying turn of material the succeeding turn of material overlapping the first line of stitching and the finishing edge of the sheet being stitched along its length to the immediately underlying turn only, out of register with the first line of stitching, whereby at least one complete turn of material is provided that contains no stitch-holes.

5. A filter cartridge according to any one of the preceding claims, wherein the former comprises a cylindrical member having a plurality of perforations, and a plurality of longitudinal ribs equally spaced around the circumference thereof, the ribs being provided with a discontinuous helical groove wherein is wound a wire having closely spaced turns to provide said inner filtering layer.

6. A filter cartridge according to any one of the preceding claims, wherein the former is provided with end pieces, one of which is an annular member having a bore adapted to receive a spindle, the other of which is an annular member provided with an internal spider having a bore adapted to receive a spindle.

7. A filter unit for a liquid comprising a cylindrical housing, an end wall permanently secured at one end of the housing, a detachable cap adapted to seal the other end of the housing, an annular internal flange adjacent said end wall, a spindle secured at one end centrally in said end wall and having means at its other end for securing said detachable cap, a filter cartridge according to Claim 6 mounted on said spindle with the spider adjacent said end wall and the respective end piece fitting within said annular internal flange, means for detachably securing said cartridge on said spindle, a liquid inlet in said housing communicating with an annular chamber formed between the cartridge and the housing, and a liquid outlet in said housing located between said annular flange and said end wall.

8. A filter cartridge substantially as described with reference to the accompanying drawings.

9. A filter unit constructed, arranged, and adapted to operate substantially as described with reference to the accompanying drawings.

For the Applicants,
RAWORTH, MOSS & COOK.
Chartered Patent Agents,
75 Victoria Street, London, S.W.1.

PROVISIONAL SPECIFICATION.

Improvements in Filters for Removing Fine Particles from Liquids.

We, AUTO-KLEAN STRAINERS LIMITED, a Company registered under the laws of Great Britain, of 115 Staines Road, Hounslow, in the County of Middlesex, do hereby declare this invention to be described in the following statement :—

This invention relates to filters for removing fine particles from liquids and is concerned with improvements in filters of the kind, referred to herein as "the kind specified", wherein the effective filtering surface is composed of a plurality of closely spaced rigid elements defining between them (or their edges) accurately dimensioned apertures or slots adapted to permit the passage of the liquid to be filtered but not of solid particles of a size above a predetermined minimum. The rigid elements may be wires or the like, whether coiled helically or not, or discs or plates arranged in parallel relation.

Due to practical considerations, the lower limit of size of the apertures or slots is of the order of 0.0005" but filters of the kind specified in which apertures of this degree of fineness are present are limited in application because of the relatively minute quantities of fine solids required to choke them and thus to interfere with the flow of the liquid therethrough.

Attempts have been made to overcome this disadvantage, either by arranging for continuous mechanical cleaning of the filter while in use or by adopting such low rates of flow of the liquid that negligible pressure differences occur between the inlet and outlet of the filter. The first expedient, while satisfactory on large plant, requires costly and complicated mechanism which is not a practical proposition for small filters. In the case of the second expedient, the filter will continue to function satisfactorily even though a layer of fine solids has built up on the filtering surface but the low flow ratings which are permissible make it impossible usefully to employ these filters save in a very few specialised applications.

It is the object of the present invention to provide simple means whereby fine meshed filters of the kind specified may be made to function continuously without early choking of the filter surface and at usefully high flow ratings.

According to the invention, in a filter of the kind specified, the effective filtering surface is covered on the inlet side by a closely fitting sheet of a porous material which is permeable by the liquid to be filtered but will normally retain fine solid particles such as are not intended to be passed by the filtering surface proper.

Where the filtering surface is of cylindrical form, the porous material is formed into a sleeve which is a close fit over the surface and is sealed tightly against the latter at its ends so that any liquid supplied to the filter is constrained to flow through the porous material before passing through the apertures or slots in the filtering surface proper. The means for securing the ends of the sleeve may be spring clips adapted to press the material of the sleeve into annular grooves of V-section formed in the former supporting the filtering surface proper. Other means may, however, be employed.

A suitable porous material is a closely felted sheet of fibres, of vegetable or animal origin, such as a felt cloth or a filter paper.

It has been found that a defined mesh filter of the kind specified, when fitted with a porous sheet of the nature indicated, may be operated continuously for relatively long periods, with complete satisfaction, at substantially higher flow ratings than is possible in the absence of the porous sheet. The latter clearly absorbs or holds within its interstices the majority of the solid matter suspended in the liquid to be filtered and it might be thought that this porous material alone would afford the filtering efficiency required. However, this is not the case because such porous materials are never completely homogeneous in structure and "channels" soon occur therein, i.e. there arise openings through which comparatively large solid particles may pass. When employed as specified above, the defined mesh of the filtering surface proper retains any particles which may pass through the porous material and at the same time provides a strong and rigid support for the latter which will prevent distortion or collapse of the porous material under the action of high differential pressures.

Moreover, the rigid supporting of the porous material reduces the "sponging" effect normally encountered with such materials, i.e. the discharge into a fresh flow of liquid passing through the material of quantities of large solids previously abstracted from liquid which was filtered prior to a stoppage of the flow for any reason.

It will be understood that the porous sheets used in accordance with this invention will be replaced by fresh ones from time to time.

For the Applicants,
RAWORTH, MOSS & COOK.
75 Victoria Street, London, S.W.1.
Chartered Patent Agents.

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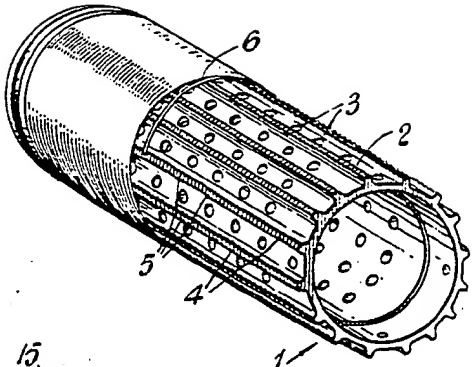

Fig. 1

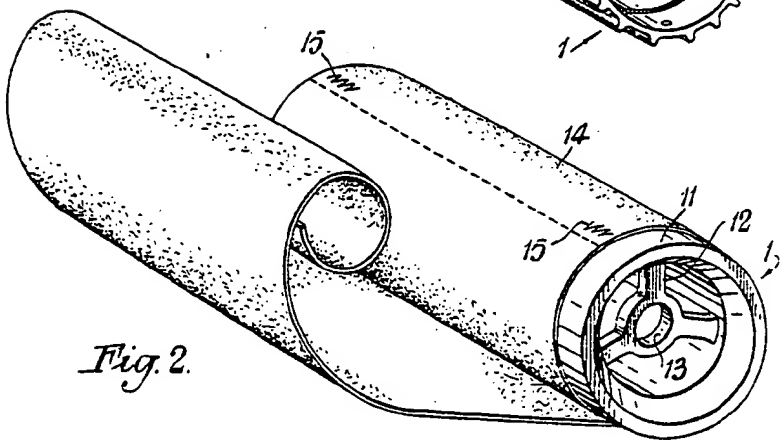

Fig. 2.

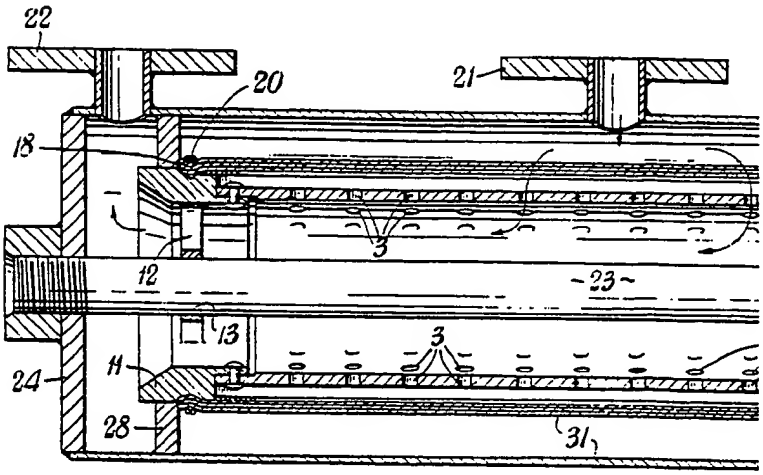

Fig. 4

772,354 COMPLETE SPECIFICATION
1 SHEET

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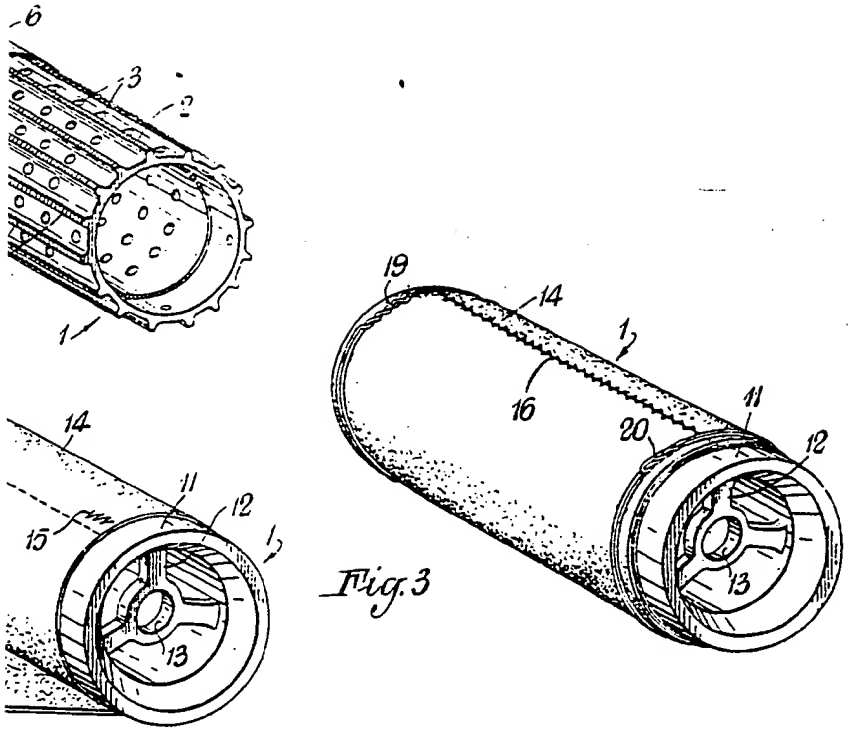

Fig. 3

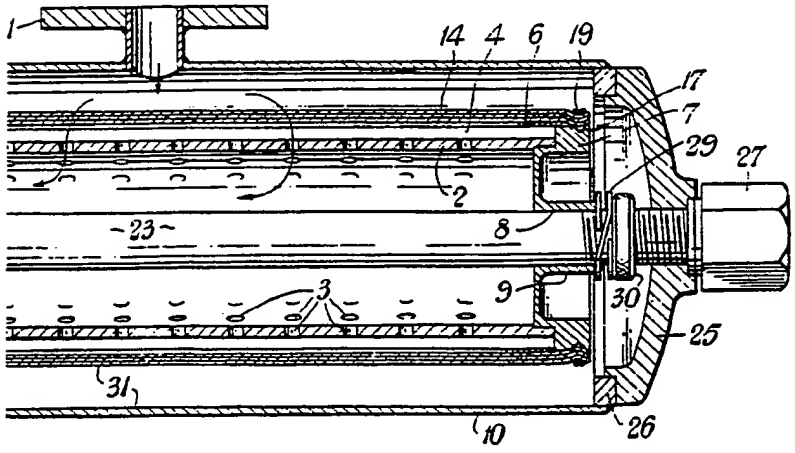

Fig. 4

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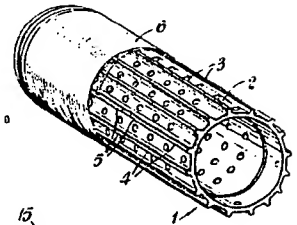
Fig. 1



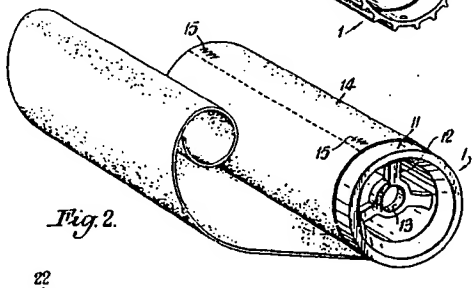


Fig. 2.

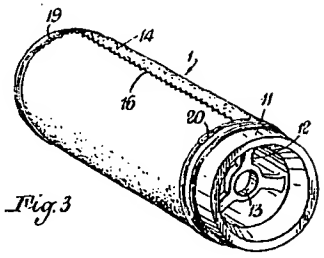


Fig. 3

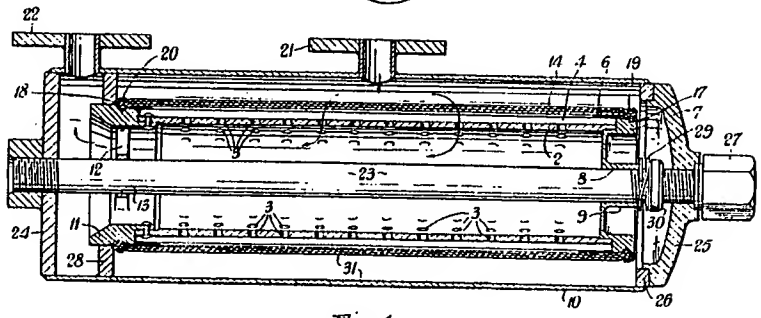


Fig. 4